

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-281516

(43)Date of publication of application : 31.10.1997

(51)Int.Cl. G02F 1/1343
G02F 1/1345

(21)Application number : 08-092246

(71)Applicant : MATSUSHITA ELECTRIC IND
CO LTD

(22)Date of filing : 15.04.1996

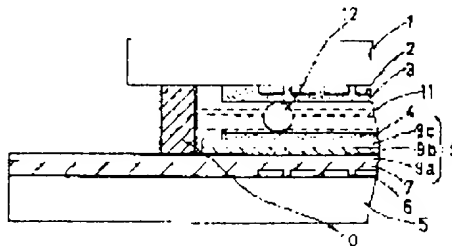
(72)Inventor : SHINSENJI SATORU
MATSUKAWA HIDEKI
MORI KOSHIRO

(54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To embody a liquid crystal display device with which the compatibility of the low resistance performance of transparent electrodes of multilayered structures contg. metallic thin films in the inside layers with the high reliability of the terminal parts to be packed with driving circuits is attained by using the transparent electrodes.

SOLUTION: The transparent electrodes 2 and an oriented film 3 are formed on one transparent substrate 1 and color filter layers 6 and smooth layer 7 are formed on another transparent substrate 5. The transparent electrodes 9 of the three-layered structures composed of an ITO film 9a/silver thin film 9b/ITO film 9c are formed on the smoothing layer 7. The oriented film 4 is formed thereon. The transparent substrates 1 and 5 are arranged to face each other via a liquid crystal layer 11 and spacers 12 enclosed which a sealing material 10. The ITO film 9a of the lowermost layer of the transparent electrodes 9 is formed from the display electrodes part on the inner side of the sealing material 10 to the terminal part to be packed with the chip of the driving circuits on the outer side of the sealing material 10. The silver thin film 9b and the ITO film 9c are formed only on the inner side of the sealing material 10. Namely, the three-layered structures are formed on the side inner than the sealing material 10 and the parts from the sealing material 10 to the terminal parts on the outer side are formed of the ITO film 9a alone.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of

[Date of the examiner's decision of rejection or
application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision
of rejection]

[Date of requesting appeal against examiner's
decision of rejection]

[Date of extinction of right]

Copyright (C); 1998,2000 Japan Patent Office

CLAIMS

[Claim(s)]

[Claim 1] It is the liquid crystal display characterized by being the liquid crystal display which ****(ed) the liquid crystal layer surrounded by the sealant in the circumference among one pair of substrates which have a transparent electrode, and for the transparent electrode on one [at least] substrate having made the inside portion the transparent electrode of the multilayer structure which contains a metal thin film in an internal layer from the aforementioned sealant among the one aforementioned pair of substrates, and making the portion of the outside of the aforementioned sealant into the transparent electrode which does not contain the aforementioned metal thin film.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] This invention relates to the liquid crystal display used for OA equipment, such as a graphic display device, a personal computer, and a word processor, the handicap terminal

equipment, etc.

[0002]

[Description of the Prior Art] The liquid crystal display is inferior in the screen size and the number of pixels compared with the display which used CRT, and, on the other hand, it was able to be located in the product field which was excellent in portability in a weight or volume. Now, as a liquid crystal display used with the notebook sized personal computer or the word processor, the number of pixels of 640x480 dots or 600x800 dots is prepared by the 10-12 inch size grade, and although it is inferior to the number of pixels of CRT, the display which was excellent as a display can be shown.

[0003] However, in a simple matrix type liquid crystal display, a difference arises to the degree of a cross talk according to the kind of pattern which the phenomenon of the cross talk which can do a shadow (shadowing) generates and displays in the in-every-direction direction of the projected picture by the design of a liquid crystal panel or a drive circuit. If voltage impression is carried out so that the pixel whose drive method of a liquid crystal panel is a line sequential color TV system may be turned on, some voltage will be added besides the pixel of lighting and the cross talk of the display which is different in it being regular will occur. Moreover, also in

form] distortion generates, a part for the voltage is impressed, and a cross talk occurs. Moreover, it is greatly influenced by the wiring resistance of the capacity component of a liquid crystal panel, or a transparent electrode which consists of liquid crystal material or a cell gap.

[0004] Drawing 3 is the cross section showing the composition of a simple matrix type color STN (super twisted nematic) liquid crystal display as a conventional liquid crystal display. drawing 3 -- setting -- 1 and 5 -- a transparent substrate, and 2 and 8 -- for a light-filter layer and 7, as for a sealant and 11, a smooth layer and 10 are [a transparent electrode, and 3 and 4 / an orientation film and 6 / a liquid crystal layer and 12] spacers This conventional liquid crystal display forms the orientation film 3 which forms a transparent electrode 2 on the transparent substrate 1, and consists of a polyimide etc. further while consisting of a glass substrate etc. The light-filter layer 6 is formed on the transparent substrate 5 of another side by which opposite arrangement is carried out with the transparent substrate 1, in order to obtain smooth nature on it, the smooth layer 7 which consists of the organic substance is formed, and the transparent electrode 8 and the orientation film 4 are formed further in order. Thus, it has pasted up so that the gap between the transparent substrate 1 and 5 may be

kept constant by the seal resin 10 printed around one [at least] substrate through a spacer 12, and into the gap, the constituted transparent substrates 1 and 5 enclose liquid crystal, and form the liquid crystal layer 11.

[0005] The present condition is that most sputtering membrane formation technology by the ITO (In-Sn oxide) target is adopted as the transparent electrodes 2 and 8 here. It is in the method of actually forming an ITO film variously, and also by print processes, an ITO film can be formed and fixed efforts are also bearing fruit it. However, print processes have the fault that it cannot become a thick film instead of a thin film, or a thin-line pattern cannot be formed. Moreover, burning temperature has the restrictions from the direction of a glass substrate at 400-600 degrees C.

[0006] On the other hand, as for the ITO film by the spatter or the EB (EB) method, for a 200-400-degree-C and low reason, formation temperature does not have a damage to a glass substrate. An electric resistance value also becomes 10ohms / ** grade by about 2,000A, and since membraneous quality is also choked up densely, electrical conductivity will be secured even if the crystal grain itself is small. Moreover, although it is dependent on equipment or a target in order to form the film of a uniform electrical property in the glass substrate of a large area, it excels in mass-production nature. In

addition, if a photolithography is used for formation of the circuit pattern of transparent electrodes 2 and 8, it keeps being 20 micrometers, can attain from width of face to several micrometers, and can extract, and what has narrow width of face can raise the formation of quantity thin energy, and panel permeability.

[0007] ** [7-10ohms /] In order to consider as a product which satisfies a user to the 10 type color STN liquid crystal display (640x480 dots) using such a transparent electrode, the sheet resistivity value of a transparent electrode is needed. More than it, in a big sheet resistivity value, a cross talk increases to a liquid crystal panel, and the phenomenon which a difference arises in a threshold voltage value in the field of right and left in a liquid crystal panel, and is called brightness inclination is also generated. This cross talk expresses the thing of the shadow (shadowing) of the vertical line by display patterns, such as gradation and a character pattern, and a horizontal line. From now on, in the STN liquid crystal display, the 17 type screen size can be considered from 12 types, and display capacity will also attract attention to XGA, SXGA, etc. as a CRT alternative monitor from SVGA. Such an inclination is also further anxious about increase of the amount of cross talks or a brightness

of the drive circuit which took the amendment voltage impression wave into consideration according to the display pattern, and a liquid crystal panel, or lowering the sheet resistivity value of a transparent electrode further are called for.

[0008] As the technique of the reduction in resistance of the above-mentioned transparent electrode, the further membrane formation method is devised or the transparent electrode of the multilayer structure which sandwiched the metal thin film is proposed. It is indicated by JP,2-37326,A as a transparent electrode of this multilayer structure, and the cross section of the substrate for electrochromatic displays is shown in drawing 4, and a plan is shown in drawing 5. drawing 4 and drawing 5 -- setting -- 13 -- for a resin protective layer and 16, as for a metal thin film and 18, the 1st metal oxide film and 17 are [a glass substrate and 14 / a light-filter layer and 15 / the 2nd metal oxide film and 19] transparent electrodes In addition, R, G, and B of drawing 5 show the color (red, green, blue) of the light-filter layer 14, respectively.

[0009] The transparent electrode 19 which consists of a three-tiered structure of the 1st 16/metal thin film 17 of metal oxide films/the 2nd metal oxide film 18 is formed on the resin protective layer 15 by

layer 14, and this transparent electrode 19 is formed by the three-tiered structure to the terminal area which mounts a drive circuit from the display polar zone. [0010]

[Problem(s) to be Solved by the Invention] However, although electrode resistance can be lowered when the transparent electrode 19 of such multilayer structure is used, the reliability of the metal thin film 17 is remarkably bad. Although it is desirable as a metal thin film 17 to use silver when transparency and conductivity are taken into consideration, if it is weak, and a blemish arises or the adhesion force with the transparent metal oxide films 16 and 18 represented by ITO leaves it the inside of highly humid in mechanical friction for a long time, moisture will permeate from the interface of the multilayer structure of the transparent electrode 19 of the lateral part of the sealant which has enclosed liquid crystal, the metal thin film 17 which consists of silver will be corroded, and problems, such as ablation, will arise. Therefore, it was far from the reliability required of the terminal area which mounts the chip of a drive circuit, and was difficult for practical use.

[0011] The purpose of this invention is offering a liquid crystal display compatible in the low resistance ability and the high reliability of the terminal area which mounts a drive circuit using the transparent electrode of the

multilayer structure which contains a metal thin film in an internal layer.

[0012]

[Means for Solving the Problem] In order to attain this purpose, the liquid crystal display of this invention is a liquid crystal display which ****(ed) the liquid crystal layer surrounded by the sealant in the circumference among one pair of substrates which have a transparent electrode, and among one pair of substrates, the transparent electrode on one [at least] substrate makes an inside portion from a sealant the transparent electrode of the multilayer structure which contains a metal thin film in an internal layer, and is characterized by making the portion of the outside of a sealant into the transparent electrode which does not contain a metal thin film.

[0013] While being able to attain low resistance-ization among one pair of substrates by making a metal thin film into the transparent electrode of the multilayer structure which contains the transparent electrode on one [at least] substrate in an internal layer for the portion of a sealant to the inside according to this composition By making the portion of the outside of a sealant into the transparent electrode which does not contain a metal thin film, even if it leaves it the inside of highly humid for a long time, high reliability can be acquired also in the terminal area which the transparent electrode of the portion of the

outside of a sealant does not corrode and mounts a drive circuit.

[0014]

[Embodiments of the Invention]

Hereafter, the gestalt of implementation of this invention is explained, referring to a drawing.

[Gestalt of the 1st operation] Drawing 1

is the cross section showing the composition of the 1st of the liquid crystal display of the gestalt of operation of this invention. As for a sealant and 11, the transparent electrode of the three-tiered structure which an orientation film and 6 become in the transparent electrode which the transparent substrate which 1 and 5 become from a glass substrate etc., and 2 become from an ITO film in drawing 1, and 3 and 4, and a smooth layer and 9 become from ITO film 9a, silver thin film (metal thin film) 9b, and ITO film 9c in a light-filter layer and 7, and 10 are [a liquid crystal layer and 12] spacers.

[0015] This liquid crystal display is a simple matrix type color STN liquid crystal display, like drawing 3, forms a transparent electrode 2 on one transparent substrate 1, and forms the orientation film 3 which consists of a polyimide etc. further. The light-filter layer 6 is formed on the transparent substrate 5 of another side by which an opposite arrangement is carried out with

layer 7 which consists of the organic substance is formed, the transparent electrode 9 of a three-tiered structure is formed on the smooth layer 7, and the orientation film 4 is formed on it. The transparent substrates 1 and 5 carry out opposite arrangement through a spacer 12 and the liquid crystal layer 11, and the liquid crystal layer 11 is surrounded by the sealant 10. A transparent electrode 9 consists of three layer membranes of ITO film 9a/silver thin film 9b/ITO film 9c, and each thickness is 500Å / 150Å / 500Å. Although ITO film 9a of the lowest layer of a transparent electrode 9 is formed to the terminal area which mounts the chip of the drive circuit of the outside of a sealant 10 from the display polar zone inside a sealant 10, silver thin film 9b and ITO film 9c are formed only inside a sealant 10. That is, the transparent electrode 9 of a three-tiered structure is formed inside a sealant 10, and the terminal area outside a sealant 10 forms only by ITO film 9a.

[0016] this liquid crystal display -- constant temperature -- when the shelf test in the inside (60 degrees C / 90%) of highly humid was performed, even if it passed 1000 hours, change was hardly looked at by the transparent electrode 9 of the three-tiered structure formed inside ITO film 9a of the outside of the sealant 10 containing a terminal area

[Gestalt of the 2nd operation] Drawing 2 is the cross section showing the composition of the 2nd of the liquid crystal display of the gestalt of operation of this invention, and has given the same sign to drawing 1 and the corresponding portion.

[0017] The liquid crystal display of the gestalt of this 2nd operation has formed the transparent electrode 9 of the three-tiered structure on the transparent substrate 5, i.e., the three-tiered structure of ITO film 9a/silver thin film 9b/ITO film 9c, inside from the lower part of a sealant 10, and other composition is the same as that of drawing 1. Therefore, each thickness of ITO film 9a/silver thin film 9b/ITO film 9c is 500Å / 150Å / 500Å, and ITO film 9a of the lowest layer of a transparent electrode 9 is formed to the terminal area which mounts the chip of the drive circuit of the outside of a sealant 10 from the display polar zone inside a sealant 10.

[0018] the gestalt of the 1st operation of this liquid crystal display -- the same -- **constant temperature -- when the shelf test in the inside (60 degrees C / 90%) of highly humid was performed, even if it passed 1000 hours, change was hardly looked at by the transparent electrode 9 of the three-tiered structure formed inside from the lower part of ITO film 9a of the outside of the sealant 10 containing a terminal area, and a sealant 10, but it was checked that there is no real use top**

problem

[0019] the former which shows the transparent electrode 9 of the same three-tiered structure to drawing 4 and drawing 5 to the composition shown in drawing 1 and drawing 2 -- like -- from the display polar zone up to the terminal area of the outside of a sealant 10 -- forming -- the same constant temperature -- when the shelf test in the inside of highly humid was performed, it is at the 100-hour progress time, the adhesion force of the interface of a silver thin film and an ITO film declined, and ablation and bulging were observed Thus, real use was not able to be borne by the conventional method.

[0020] According to the gestalt of the above 1st and the 2nd implementation, the portion of a sealant 10 to the inside as mentioned above by considering as the transparent electrode 9 of the three-tiered structure which contains silver thin film 9b of a metal thin film in an internal layer for the transparent electrode by the side of the transparent **substrate 5 Can attain low** resistance-ization, and according to the effect of the reduction in resistance, while being able to reduce display nonuniformity, such as a cross talk and a brightness inclination, also on a big screen and a highly minute screen By making the portion of the outside of a sealant 10 into the transparent electrode (drawing 2 drawing 1, ITO film 9a chisel)

which does not contain silver thin film 9b of a metal thin film. Even if it leaves it the inside of highly humid for a long time, high reliability can be acquired also in the terminal area which the transparent electrode (ITO film 9a) of the portion of the outside of a sealant 10 does not corrode, and mounts a drive circuit, and the liquid crystal display excellent in environmental reliability can be realized. [0021] Moreover, while the transparent electrode 2 by the side of the transparent substrate 1 can also reduce display nonuniformity further according to the same three-tiered structure as the transparent substrate 5 side, then the effect of the reduction in resistance, high reliability can be acquired also in the terminal area which mounts the drive circuit by the side of the transparent substrate 1. In addition, although considered as the transparent electrode 9 of the three-tiered structure of ITO film 9a/silver thin film 9b/ITO film 9c with the gestalt of the above-mentioned implementation, what is necessary is just a conductive metal oxide film more transparent than the transparent substrate 5 side as the 1st layer. As a metal thin film of the 2nd layer, silver, copper, or these alloys are sufficient, a transparent metal oxide film with adhesion sufficient as the 3rd layer with

[0022] Moreover, although the transparent electrode 9 was made into the three-tiered structure, the multilayer structure of four or more layers is sufficient. Also in this case, a metal thin film shall be formed as an internal layer, and a metal thin film shall not be formed in the portion of the outside of a sealant. Moreover, a metal oxide film should just be used for layers other than a metal thin film.

[0023]

[Effect of the Invention] According to this invention, the portion of a sealant to the inside among one pair of substrates as mentioned above by considering as the transparent electrode of the multilayer structure which contains a metal thin film in an internal layer for the transparent electrode on one [at least] substrate. Can attain low resistance-ization, and according to the effect of the reduction in resistance, while being able to reduce display nonuniformity, such as a cross talk and a brightness inclination, also on a big screen and a highly minute screen. By making the portion of the outside of a sealant into the transparent electrode which does not contain a metal thin film. Even if it leaves it the inside of highly humid for a long time, high reliability can be acquired also in the terminal area which the transparent electrode of the

and the liquid crystal display excellent in environmental reliability can be realized.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The cross section showing the composition of the 1st of the liquid crystal display of the gestalt of operation of this invention.

[Drawing 2] The cross section showing the composition of the 2nd of the liquid crystal display of the gestalt of operation of this invention.

[Drawing 3] The cross section showing the composition of the conventional liquid crystal display.

[Drawing 4] The cross section of the substrate for electrochromatic displays of the conventional liquid crystal display which used the transparent electrode of multilayer structure.

[Drawing 5] The plan of the substrate for electrochromatic displays of the conventional liquid crystal display which used the transparent electrode of **multilayer structure**.

[Description of Notations]

- 1 Five Transparent substrate
- 2 Transparent Electrode
- 3 Four Orientation film
- 6 Light Filter
- 7 Smooth Layer
- 9 Transparent Electrode of Three-tiered Structure
- 9a ITO film

9b Silver thin film (metal thin film)

9c ITO film

10 Sealant

11 Liquid Crystal Layer

12 Spacer

1

【特許請求の範囲】

【請求項1】 透明電極を有する1対の基板間に周辺をシール材で囲まれた液晶層を挟持した液晶表示装置であって、

前記1対の基板のうち少なくとも一方の基板上の透明電極は、前記シール材から内側の部分を金属薄膜を内部層に含む多層構造の透明電極とし、前記シール材の外側の部分を前記金属薄膜を含まない透明電極としたことを特徴とする液晶表示装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】この発明は、映像表示機器、パーソナルコンピュータやワードプロセッサなどのOA機器、産業分野のハンディ端末機器、携帯型情報通信機器などに用いられる液晶表示装置に関するものである。

【0002】

【従来の技術】液晶表示装置は、CRTを用いた表示装置に比べて、画面サイズ、画素数において劣っており、その反面、重量や体積において携帯性に優れた製品分野に位置することができた。現在では、ノート型パソコンやワープロで用いられている液晶表示装置として、10～12インチサイズ程度で640・480ドットや600・800ドットの画素数が用意されており、CRTの画素数には劣るがディスプレイとして優れた表示を示すことができる。

【0003】しかし、単純マトリクス型の液晶表示装置では、液晶パネルや駆動回路の設計により、映し出された画像の縦横方向に影（シャドウイング）ができるクロストークという現象が発生し、表示するパターンの種類によってクロストークの度合いに差が生じる。液晶パネルの駆動方法が線順次方式である画素を点灯するように電圧印加すると、点灯の画素以外にも多少の電圧が加わり、正規と違う表示のクロストークが発生する。また、交流化信号の際にも信号波形の歪み分が発生し、その電圧分が印加されてクロストークが発生する。また、液晶材料やセルギャップからなる液晶パネルの容量成分や透明電極の配線抵抗値によっても大きく左右される。

【0004】図3は従来の液晶表示装置として単純マトリクス型のカラーSTN（スーパーツイステッドネマティック）液晶表示装置の構成を示す断面図である。図3において、1、5は透明基板、2、8は透明電極、3、4は配向膜、6はカラーフィルタ層、7は平滑層、10はシール材、11は液晶層、12はスペーサである。この従来の液晶表示装置は、ガラス基板などからなる一方の透明基板1の上に透明電極2を形成し、さらにポリイミドなどからなる配向膜3を形成している。透明基板1と対向配置される他方の透明基板5上にはカラーフィルタ層6を形成し、その上に平滑性を得るために有機物からなる平滑層7を形成し、さらに透明電極8と配向膜4を順に形成している。このように構成した透明基板1と

2

5は、スペーサ12を介して、少なくとも一方の基板の周辺に印刷されたシール樹脂10で透明基板1、5間のギャップを一定に保つように接着されており、そのギャップ中に液晶を封入して液晶層11を形成している。

【0005】ここでの透明電極2、8には、ITO（In-Sn酸化物）ターゲットによるスパッタリング成膜技術が最も多く採用されているのが現状である。実際にITO膜を形成する方法には色々あり、印刷法によってもITO膜は形成でき、一定の成果も上がっている。しかし、印刷法には、薄膜ではなく厚膜となったり、細線パターンを形成できないという欠点がある。また、焼成温度は400～600℃でガラス基板の方からの制約がある。

【0006】一方、スパッタ法やEB（エレクトロンビーム）法によるITO膜は、形成温度が200～400℃と低いため、ガラス基板へのダメージがない。電気抵抗値も約2,000Ωで10Ω/□程度になり、膜質も密に詰まっているために結晶粒自体は小さくても電気伝導性が確保されることになる。また、大面積のガラス基板に均一な電気特性の膜を形成するには、装置やターゲットに依存するが、量産性に優れている。なお、透明電極2、8の配線パターンの形成にはフォトリソグラフィを用いれば、20μmの抜き幅から数μmまで達成でき、抜き幅が狭いものほど高細精化やパネル透過率を高めることができる。

【0007】このような透明電極を用いた10型カラーSTN液晶表示装置（640・480ドット）でユーザーを満足させるような製品とするには、透明電極の面積抵抗値が7～10Ω/□必要とされている。それ以上大きな面積抵抗値では液晶パネルにクロストークが増大し、液晶パネルの中の左右の領域でしきい値電圧値に差が生じて輝度傾斜と呼ばれる現象も発生する。このクロストークは階調や文字パターンなどの表示パターンによる縦線、横線の影（シャドウイング）のことを表す。今後、STN液晶表示装置では12型から17型の画面サイズが考えられており、表示容量もSVGAからXGA、SXGAなどもCRT代替モニターとして注目されている。このような傾向にもさらにクロストーク量や輝度傾斜の増大が懸念されており、表示パターンに合わせて補正する電圧印加波形を考慮した駆動回路、液晶パネルのC（容量成分）とR（抵抗成分）を下げることや、透明電極の面積抵抗値をさらに下げることが求められている。

【0008】上記の透明電極の低抵抗化の手法として、さらなる成膜方法を工夫したり、金属薄膜を挟んだ多層構造の透明電極が提案されている。この多層構造の透明電極としては、特開平2-37326号公報に開示されており、そのカラー液晶用基板の断面図を図4に、平面図を図5に示す。図4、図5において、13はガラス基板、14はカラーフィルタ層、15は樹脂保護層、16

は第1の金属酸化膜 17は金属薄膜 18は第2の金属酸化膜、19は透明電極である。なお、図5のR、G、Bはそれぞれカラーフィルタ層14の色（赤、緑、青）を示す。

【0009】このカラー液晶用基板は、カラーフィルタ層14上に形成された樹脂保護層15の上に、第1の金属酸化膜16、金属薄膜17、第2の金属酸化膜18の3層構造からなる透明電極19が形成されており、この透明電極19は、表示電極部から駆動回路を実装する端子部まで3層構造で形成されている。

【0010】

【発明が解決しようとする課題】しかしながら、このような多層構造の透明電極19を用いた場合、電極抵抗を下げることはできるが、金属薄膜17の信頼性が著しく悪い。金属薄膜17として、透明度・導電性を考慮すると銀を使うことが望ましいが、ITOに代表される透明な金属酸化膜16、18との密着力が弱く、機械的な摩擦で傷が生じたり、高温中に長時間放置すると、液晶を封入しているシール材の外側部分の透明電極19の多層構造の界面から水分が浸入し、銀からなる金属薄膜17が腐食され剥離等の問題が生じる。したがって、駆動回路のチップを実装する端子部に要求される信頼性にはほど遠いもので、実用には難しいものであった。

【0011】この発明の目的は、金属薄膜を内部層に含む多層構造の透明電極を用いて、その低抵抗性能と駆動回路を実装する端子部の高い信頼性とを両立することのできる液晶表示装置を提供することである。

【0012】

【課題を解決するための手段】この目的を達成するためにはこの発明の液晶表示装置は、透明電極を有する1対の基板間に周辺をシール材で囲まれた液晶層を挟持した液晶表示装置であって、1対の基板のうち少なくとも一方の基板上の透明電極は、シール材から内側の部分を金属薄膜を内部層に含む多層構造の透明電極とし、シール材の外側の部分を金属薄膜を含まない透明電極としたことを特徴とする。

【0013】この構成によれば、1対の基板のうち少なくとも一方の基板上の透明電極を、シール材から内側の部分を金属薄膜を内部層に含む多層構造の透明電極とすることにより、低抵抗化を図ることができるとともに、シール材の外側の部分を金属薄膜を含まない透明電極とすることにより、高温中に長時間放置してもシール材の外側の部分の透明電極が腐食することがなく、駆動回路を実装する端子部においても高い信頼性を得ることができ

いて、1、5はガラス基板等からなる透明基板、2はITO膜からなる透明電極、3、4は配向膜、6はカラーフィルタ層、7は平滑層、9はITO膜9a、銀薄膜（金属薄膜）9bおよびITO膜9cからなる3層構造の透明電極、10はシール材、11は液晶層、12はスパーサである。

【0015】この液晶表示装置は、単純マトリクス型のカラーSTN液晶表示装置であり、図3同様、一方の透明基板1の上に透明電極2を形成し、さらにポリイミドなどからなる配向膜3を形成している。透明基板1と対向配置される他方の透明基板5上にはカラーフィルタ層6を形成し、その上に平滑性を得るために有機物から成る平滑層7を形成し、平滑層7の上に3層構造の透明電極9を形成し、その上に配向膜4を形成している。透明基板1と5はスパーサ12および液晶層11を介して対向配置し、液晶層11はシール材10で囲まれている。透明電極9は、ITO膜9a、銀薄膜9b、ITO膜9cの3層膜からなり、それぞれの膜厚は、500Å、150Å、500Åである。透明電極9の最下層のITO膜9aは、シール材10の内側の表示電極部からシール材10の外側の駆動回路のチップを実装する端子部まで形成しているが、銀薄膜9bおよびITO膜9cは、シール材10の内側にのみ形成している。すなわち、シール材10より内側に3層構造の透明電極9を形成し、シール材10より外側の端子部まではITO膜9aのみで形成している。

【0016】この液晶表示装置を恒温高温中（60℃、90％）での放置試験を行ったところ、1000時間を経過しても端子部を含むシール材10の外側のITO膜9aおよびシール材10の内側に形成された3層構造の透明電極9にはほとんど変化は見られず、実使用上問題がないことが確認された。

【第2の実施の形態】図2はこの発明の第2の実施の形態の液晶表示装置の構成を示す断面図であり、図1と対応する部分には同一符号を付してある。

【0017】この第2の実施の形態の液晶表示装置は、透明基板5上の3層構造の透明電極9、すなわちITO膜9a、銀薄膜9b、ITO膜9cの3層構造をシール材10の下側に、すなわち内側に形成しており、その他の構成は図1と同様である。したがって、ITO膜9a、銀薄膜9b、ITO膜9cのそれぞれの膜厚は、500Å、150Å、500Åであり、透明電極9の最上層のITO膜9aは、シール材10の内側の表示電極部からシール材10の外側の駆動回路のチップを実装する端子部まで形成している。

んど変化は見られず、実使用上問題がないことが確認された。

【0019】図1、図2に示す構成に対して、同様の3層構造の透明電極9を、図4、図5に示す従来のように表示電極部からシール材10の外側の端子部まで形成し、同様の恒温高湿中での放置試験を行ったところ、100時間経過時点で銀薄膜とITO膜との界面の密着性が低下し、剥離や腫れが観測された。このように、従来の方法では実使用には耐えられなかった。

【0020】以上のように上記第1および第2の実施の形態によれば、透明基板5側の透明電極を、シール材10から内側の部分を金属薄膜の銀薄膜9bを内部層に含む3層構造の透明電極9とすることにより、低抵抗化を図ることができ、その低抵抗化の効果により、大画面・高精細画面でもクロストークや輝度傾斜などの表示ムラを低減することができるとともに、シール材10の外側の部分を金属薄膜の銀薄膜9bを含まない透明電極（図1、図2ではITO膜9aのみ）とすることにより、高湿中に長時間放置してもシール材10の外側の部分の透明電極（ITO膜9a）が腐食することがなく、駆動回路を実装する端子部においても高い信頼性を得ることができ、環境信頼性に優れた液晶表示装置を実現できる。

【0021】また、透明基板1側の透明電極2も透明基板5側と同様な3層構造とすれば、その低抵抗化の効果により表示ムラをさらに低減することができるとともに、透明基板1側の駆動回路を実装する端子部においても高い信頼性を得ることができ、なお、上記実施の形態では、ITO膜9a／銀薄膜9b／ITO膜9cの3層構造の透明電極9としたが、透明基板5側より第1層目としては、透明な導電性の金属酸化膜であればよい。第2層目の金属薄膜としては、銀もしくは銅またはこれらの合金でも良い。第3層目としては、下地との密着性がよい透明な金属酸化膜であればよく、たとえばTiO₂、ZrO₂、Ta₂O₅、Al₂O₃、Bi₂O₃およびSiO₂等も用いることができる。

【0022】また、透明電極9を3層構造としたが、4層以上の多層構造でもよい。この場合も、金属薄膜を内部層として形成し、シール材の外側の部分には金属薄膜

を形成しないものとする。また、金属薄膜以外の層は、金属酸化膜を用いればよい。

【0023】

【発明の効果】以上のようにこの発明によれば、1対の基板のうち少なくとも一方の基板上の透明電極を、シール材から内側の部分を金属薄膜を内部層に含む多層構造の透明電極とすることにより、低抵抗化を図ることができ、その低抵抗化の効果により、大画面・高精細画面でもクロストークや輝度傾斜などの表示ムラを低減することができるとともに、シール材の外側の部分を金属薄膜を含まない透明電極とすることにより、高湿中に長時間放置してもシール材の外側の部分の透明電極が腐食することがなく、駆動回路を実装する端子部においても高い信頼性を得ることができ、環境信頼性に優れた液晶表示装置を実現できる。

【図面の簡単な説明】

【図1】この発明の第1の実施の形態の液晶表示装置の構成を示す断面図。

【図2】この発明の第2の実施の形態の液晶表示装置の構成を示す断面図。

【図3】従来の液晶表示装置の構成を示す断面図。

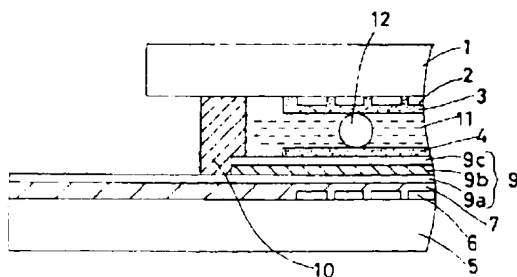
【図4】多層構造の透明電極を使用した従来の液晶表示装置のカラー液晶用基板の断面図。

【図5】多層構造の透明電極を使用した従来の液晶表示装置のカラー液晶用基板の平面図。

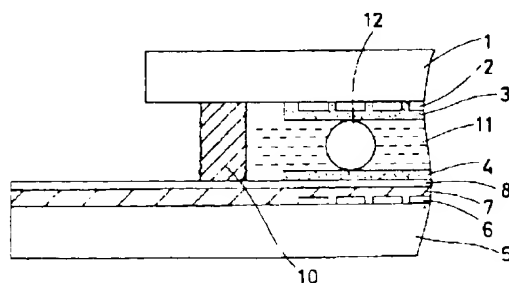
【符号の説明】

- 1、5 透明基板
- 2 透明電極
- 3、4 配向膜
- 6 カラーフィルタ
- 7 平滑層
- 9 3層構造の透明電極
- 9a ITO膜
- 9b 銀薄膜（金属薄膜）
- 9c ITO膜
- 10 シール材
- 11 液晶層
- 12 スペース

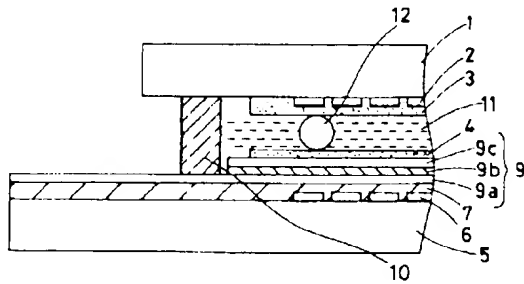
【図2】



【図3】

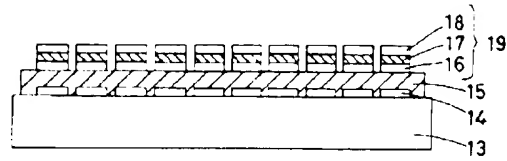


【図1】



- | | | | | |
|----|---|---------|----|-------------|
| 1. | 5 | 透明基板 | 9a | ITO膜 |
| 2. | 2 | 透明電極 | 9b | ITO膜 (金属薄膜) |
| 3. | 4 | カラーフィルタ | 9c | ITO膜 |
| 4. | 6 | 封止剤 | 10 | シール材 |
| 5. | 7 | 偏光板 | 11 | 液晶層 |
| 6. | 8 | 光源 | 12 | スペーサ |

【図4】



【図5】

